Targeting Newlands Project Acquisitions

The Secretary of the Interior has responsibility to assist in the recovery of the endangered cui-ui fish in Pyramid Lake, to maintain an average of 25,000 acres of wetlands downstream from the Newlands Project, and to meet his trust responsibility to the Fallon Paiute-Shoshone Tribes whose irrigated lands are served by Newlands Project facilities. It is possible that as much as 110,000 acre-feet of additional water will be needed to achieve cui-ui recovery, and that a total of 125,000 acre-feet of water rights will need to be acquired to maintain 25,000 acres of wetlands downstream from the Newlands Project. At present the U.S. Fish and Wildlife Service is only transferring 2.99 of every 3.5 acre-feet they acquire; if this continues, the Service would need to acquire 146,000+ acre-feet of water rights to transfer 125,000 acre-feet annually to the wetlands. Thus, the total quantity of additional water needed to meet the Secretary's obligations could be as high as 256,000 acre-feet annually (110,000 + 146,000).

The most likely source of this additional water is the Newlands Project. In 1989 and 1993, the most recent years that a full water supply was available for the Project, 344,311 and 314,250 acre-feet, respectively, were diverted to the Project. If 256,000 acre-feet of these diversions had instead been used to meet other Secretarial responsibilities then only 58,250 to 88,311 acre-feet would have been available for irrigation in those two years, respectively. In 1993 an average of 5.34 acre-feet of water was diverted for each irrigated Project acre. If this same rate is applied to the remaining water calculated above, a Project of only 10,900 to 16,500 acres could have been irrigated, only about 20 to 30 percent of the approximately 59,000 acres currently irrigated. The potential number of irrigated acres would be increased if the delivery efficiency was increased above its current level.

It is possible that the Secretary will need to acquire and transfer water rights from approximately two-thirds of the Newlands Project to meet his obligations to wetlands, endangered species, and Indian tribes. If the acquisitions are made in a scattered, shotgun pattern then deliveries to the remaining irrigated acres will be relatively inefficient since most of the Project delivery canals would still be in use and much of the water available to the Project would go to seepage losses to make deliveries. Acquiring water rights so that a core area of the Project is left under irrigation would concentrate remaining agricultural lands and allow deliveries through a much smaller number of canals. This would reduce seepage losses, allow a greater percentage of the water available for irrigation to reach the remaining farms, and consequently allow a greater number of acres to remain under irrigation.

The bottom line is that the amount of water available for irrigation could eventually decrease by as much as two-thirds as the Secretary acquires and transfers Newlands Project water rights to meet his responsibilities. Most of the remaining water will be split between application to irrigated lands and seepage losses to deliver that water. The seepage losses can be minimized and irrigation application maximized by minimizing the miles of remaining delivery canals; currently about one-third of diverted water is lost to seepage. This would tend to concentrate the remaining agricultural lands in one area and/or along the remaining active canals.

It would be beneficial to attempt to determine which areas of the Project would be best to retain in agricultural production to maximize the benefits to affected parties and minimize negative impacts. With an ultimate vision of the future Project, actions such as the U.S. Fish and Wildlife acquisition of lands could be steered to accomplish that vision.

Some Project canal systems have already been identified in the Newlands Project Efficiency Study as good candidates for retirement; the N and T canal systems, which serve about 4,700 acres, have relatively high seepage losses per acre of water delivered, and minimal drain flows from these areas reach the wetland areas which Public Law 101-618 seeks to protect and enhance.

(C.Grenier, 10/20/94, /effic/targetng)

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Estimated 1993 Losses & Water Use Per Irrigated Acre
Newlands Project

canal system	deliveries (ac-ft)	estimated seepage (ac-ft)	total (ac-ft)	irrigated water-righted acres	seepage loss per irrigated acre (ac-ft)	total water used per irrigated acre (ac-ft)	drain flows go to wetlands ?	estimated seepage losses	productivity
A	26,311.31	7,280	33,591	8,137.7	0.89	4.1	yes	medium	
D[1]	4,472.37	1,898	6,370	1,217.7	1.56	5.2	no	medium	
E[2]	2,222.67	907	3,130	567.2	1.60	5.5	no	medium	
G[3]	14,035.97	5,362	19,398	2,986.3	1.80	6.5	yes	med/high	
L[4]	33,736.56	10,540	44,277	9,551.9	1.10	4.6	yes	med/low	
N	4,262.94	4,407	8,670	1,029	4.28	8.4	no	high	
R[5]	6,559.85	1,183	7,743	5,670.2	0.21	1.4	no	low	
Rock Dam Ditch[6]	3,164.05		3,164		??	??	no	high	
S[7]	44,942.36	8,243	53,185	14,346.5	0.57	3.7	yes	low	
T[8]	17,926.21	19,732	37,658	3,664.9	5.38	10.3	no	high	
Truckee Canal[9]	16,488.19		16,488	2,718.6	0.00	6.1	no	low to high	
V[10]	11,411.67	3,576	14,988	2,639.8	1.35	5.7	no	medium	
Totals	187,527.15	65,121	250,655	54,522.80					

(C.Grenier, 10/20/94, /effic/targetng)

1	Figures for the D Canal do NOT include 135.95 acre-feet of deliveries and the associated losses for Thirty-One Corporation, whose deliveries comprise 3 percent of D Canal deliveries.
2	Figures for the E Canal are missing information for the E2 and E3 laterals whose deliveries comprise 29 percent of E Canal deliveries; data on the length of these canals was not available. Also, note that unlike other Project canals, deliveries to E Canal turnouts are not diverted through the head of the E Canal at Sheckler Reservoir as they used to be until 1991. They are instead routed through the A Canal.
3	The length of the GD lateral, whose deliveries comprise less than 1 percent of G Canal deliveries, was not available so its seepage estimate is not included.
4	The lengths of the L3, L3-1, L3-2, L8-2-3, L8-2-4, and L10-1-1 laterals and sublaterals, whose deliveries comprise 4 percent of L Canal deliveries, were not available so their seepage estimates are not included.
5	The lengths of the R4-1, R7-3, R10, R11, R11-1, and R12 laterals and sublaterals, whose deliveries comprise 16 percent of R Canal deliveries, were not available so their seepage estimates are not included.
6	The lengths of all 3 Rock Dam Ditch canals and laterals were not available and their seepage estimates were not included.
7	The lengths of the S7-3, S7-4, S7-5, S10-1, S25-2, S26 and S26-4 laterals and sublaterals, whose deliveries comprise 7 percent of S Canal deliveries, were not available so their seepage estimates are not included.
8	The lengths of the T6-1, T7-1, and T17 laterals and sublaterals, whose deliveries comprise 2 percent of T Canal deliveries, were not available so their seepage estimates are not included.
9	The lengths of the Truckee Canal laterals and sublaterals were not available so their seepage estimates are not included.
10	The lengths of the V1-1 and V1-2 sublaterals, whose deliveries comprise 4 percent of V Canal deliveries, were not available so their seepage estimates are not included.

(C.Grenier, 10/20/94, /effic/targeting)

Estimate of Diversions Required To Make Deliveries To Newlands Project Canal and Lateral Systems in 1993

Estimate #2 - C.Grenier, October 1994

Purpose: The 1994 Newlands Efficiency Study looked at several areas of the Newlands Project and estimated the diversion savings which would result from taking lands along a few selected canals and laterals out of production. Bill Bettenberg requested that a similar analysis be developed for all the Project canals and laterals in order to evaluate the relative benefits of buying up land in various parts of the Project.

Method: Limited data and time were available to perform this analysis. A description of the data used to arrive at the results is listed in the next section *(Data Used to Determine Delivery Savings)*, along with data limitations and a description of what steps could be taken to obtain better data.

When all the lands served by a lateral/canal are taken out of production, the lateral/canal is no longer needed to make deliveries. Two sources of water savings result:

1) Delivery savings

When a parcel of land is no longer irrigated, the amount of water which was annually applied to that parcel in the past no longer needs to be diverted. This quantity can be derived with a fair degree of accuracy from the Truckee-Carson Irrigation District (TCID) water delivery records.

2) Transportation savings

When a specified amount of water is diverted (Lahontan Dam is the diversion point for the Carson Division which comprises about 90 percent of the Newlands Project) to make a delivery to a parcel, a lesser amount actually reaches the parcel due to transportation losses along the way. As the water travels to the parcel, some may evaporate, seep into the ground, or be absorbed by plants. The largest component of losses on the Newlands Project is seepage; most of the canals and laterals are unlined. Transportation losses are difficult to estimate due to lack of data.

Data Used to Determine Delivery Savings

1) **Acre-feet delivered to each lateral** - Extracted from database containing 1993 TCID water delivery records (ORDERS93.DBF).

limitations:

a) Deliveries to multiple laterals/turnouts

Of the 12,216 deliveries[1], 1410 (11.5 percent) have multiple turnouts listed[2]. There is no way to determine whether the delivery was split evenly between the turnouts listed.

Also, 23 deliveries[3] were made to multiple turnouts listed as "ALL", e.g., "D1-ALL" indicated the delivery was made to all turnouts on the D1 lateral. But you rarely know how many turnouts "ALL" includes, making it difficult to divide the delivery amount. And "ALL" does not necessarily indicate that all D1 lateral turnouts were used; it may mean that all D1 lateral turnouts *which serve the indicated parcel* were used. This is not a problem if "D1-ALL" is the only turnout listed, but if other laterals are also listed it becomes even more difficult to allocate flows among various turnouts and laterals.

b) Accuracy of records

As discussed at length in the 1994 Newlands Efficiency Study, Reclamation estimates that the delivery records underreport the quantity of water supplied for the average delivery by 10 to 25 percent. But this is only on the average; delivery amounts are sometimes significantly overestimated as well. The analysis of the water savings from removing specific laterals will reflect these inaccuracies, and the net effect is that on the average the delivery savings from removing a lateral from use are greater than estimated.

2) **Seepage Rate For Each Lateral** - Estimated from ponding test data and overall losses from Project water balance. Ponding tests were performed for

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[1] dBASE command: count for acre_feet>0.01.and.adjustment<0.01 = 12,216. There were 12,759 delivery records, but some were for adjustments, transfers, etc.

[2] dBASE command: count for len(trim(laterals))>9.or.at('ALL',laterals)>0

[3] dBASE command: count for at('ALL',laterals)>0 = 23

the Newlands Efficiency Study at 11 locations on the Project. Estimated seepage rates for each canal and lateral were estimated based on the results of these tests and knowledge of area soils.

limitations:

Little Seepage Rate Data Available

Seepage rate data are available for 11 locations where ponding tests were performed for the Newlands Efficiency Study. Three or four tests were performed at each location, with the exception of the Truckee Canal where only two tests were made. In addition, there are data available from a ponding test made on the S Canal in March 1990 and the A Canal in September 1994 by Reclamation's Fallon Field Office. However, about 250 canals, laterals, and sublaterals are listed in the 1993 delivery records, so no seepage data are available for over 95 percent of Project canals.

On a more positive note, the seepage data which are available show a fairly consistent pattern: higher seepage rates on the upstream (west) end of the Project and lower seepage rates as you progress downstream both to the south and to the east. Seepage rates used in this analysis are interpolations of known data, tempered by personal knowledge of the Project.

Seepage Rate Inconsistent For Same Location

As seen in the efficiency study ponding tests, seepage rates decrease during ponding tests and may vary greatly between different tests at the same location. The greatest differences were observed between seepage rates measured during the first irrigation of the year and those measured later. The seepage rates used in this analysis are those judged most representative; generally, early season test results were ignored, and the rates measured at the beginning of tests at a location were averaged.

3) **Canal Dimensions (length and wetted perimeter)** - The canal dimensions are needed to determine the area to which the seepage rate is applied. Length from measurements by Chuck Vincent in Reclamation's Fallon Field Office. Wetted perimeter from estimates and field measurements by Reclamation.

Limited Data Available

Data on canal lengths were available for about 90 percent of the canals. Wetted perimeter data were available for many of the main canals but not for smaller canals and laterals. Wetted perimeters for these were estimated.

Wetted Perimeter Varies

The wetted perimeter of a canal varies along the canal length and with different delivery flows.

4) **Number of Days Lateral Is Used Annually** - Determined from TCID 1993 delivery records.

limitations:

a) Whole Day Is Counted

The seepage rate was applied for the whole day if records showed that a canal/lateral was used for any part of the day. This would tend to overestimate the amount of seepage losses saved by taking canals out of service; the overestimate is likely to be higher for smaller, less frequently used laterals. This error is offset somewhat by the next limitation (no seepage calculated while canals have water but no deliveries are being made).

b) No Seepage Calculated While Canals Have Water But No Deliveries

Seepage losses were only calculated for days when deliveries occurred. But there is water in laterals, especially smaller less-frequently used ones, while they are being filled prior to delivery, while draining after deliveries, and sometimes between deliveries if the canal is not drained. This would tend to underestimate the amount of seepage losses saved by taking canals out of service; the underestimate is likely to be worse for smaller, less frequently used laterals. This error is offset somewhat by the previous limitation (whole day is counted).

5) **Acres Served By Laterals** - The number of acres served by each lateral was derived from TCID records by Reclamation's Fallon Field Office. This information is not easy to extract; figures from two databases must be combined. Although the records are not complete, fairly good information can be obtained.

(C.Grenier, 10/20/94, /newlands/delivrec/lat_anal.1)

Selection of Estimated Seepage Rates

Limited seepage rate data are available for the Newlands Project's largely unlined canals. Ponding tests performed in 11 locations for the 1993 Newlands Efficiency Study provide most of the hard data. Generally, these tests show that seepage rates are highest at the west (upstream) end of the Project and decrease by an order of magnitude on the east side. The tests also showed that seepage rates measured at the beginning of the irrigation season were often 2 to 3 times higher than those measured after the first few weeks. Seepage rates measured after the start of the irrigation season were fairly constant regardless of the month in which they were measured; this suggests that once the ground water in the vicinity of the canal is recharged by the first irrigations of the season, the seepage rate becomes relatively steady.

Seepage Rates for Newlands Project Canals based on 1992-93 Ponding Tests

canal/lateral	seepage rate ($ft^3/ft^2/day$)	
	range[1]	used in this analysis[2]
Truckee Canal	0.9 - 1.3	1.1
N	1.2 - 1.9, 2.1	2.0
V1	0.6 - 1.6, 2.5	2.0
A1	0.9 - 2.6, 3.5	3.0
L1-6	0.6 - 1.6, 1.8	1.7
L1-1	0.9 - 1.4, 1.8	1.6
L5	0.2 - 0.3, 1.1	0.7
L8	0.4 - 1.5, 1.6	1.5
A15	0.5 - 0.9, 1.9	1.4
S17	0.1 - 0.2, 0.6	0.4
S18	0.1 - 0.3	0.3

1 When two numbers are shown for the high end of the range, that indicates the highest seepage rates measured for two different ponding tests.

2 The seepage rate used in this analysis is the seepage rate measured when the water level was the highest during the ponding tests; the highest seepage rates occurred when the water levels were also highest. The seepage rate usually decreased as the water level in the test section decreased, but the canals are usually operated full. When different maximum seepage rates were observed for different tests at the same location, an average of the highest seepage rates was used.

Seepage rates for various canals and laterals were estimated using these ponding test results and using personal knowledge of the Project by Reclamation personnel in the Lahontan Basin Area Office. Canals near a ponding test site were assigned the seepage rate measured at that site. Canals between two or more test sites used a seepage rate somewhere between the seepage rates measured at those sites.

The seepage rate for most main canals was assumed to be very low, usually 0.1 or 0.2 $ft^3/ft^2/day$. This is because most main canals, including the V, S, T, A, and L, are constantly in use over the irrigation season; once the local ground water table is recharged, it takes less water to recharge it. In the large canals there is anecdotal evidence that some of the fine particles suspended in the water settle out and plug up some of the pores in the canal, reducing seepage. A ponding test at the head of the S Canal, a main Project canal, was performed in March 1990 by Reclamation personnel. The average seepage rate measured was 0.15 $ft^3/ft^2/day$.

Not all main canals follow this pattern. Ponding tests on the N Canal yielded some of the highest seepage rates measured on the Project. However, unlike most other main canals, the N Canal is generally in sandy soils and is only used approximately 75 percent of the time.

Detailed Derivation of Seepage Rates Used

A — **Use 0.2**. The ponding tests on the A1 and A15 laterals showed seepage rates of 3.0 and 1.5 respectively, but a ponding test on the main A Canal was performed in September 1994, and although only preliminary results are available to date, the test showed seepage in the range of 0.2 $ft^3/ft^2/day$. (It was originally thought that the main canal might have a higher seepage rate than other main canals because it overlaps an old channel of the Carson River. Such channels tend to have gravelly soils which conduct water quickly; a canal over the channel is likely to have a higher seepage rate than it otherwise would since it takes more water to keep the ground water recharged because it is flowing away more quickly than it would in denser soils. The recent ponding test was performed to ascertain whether this was true.)

A1 — **Use 3.0** based on 1992-93 ponding tests

A2 - A7 — **Use 3.0** since these laterals are in the same area as the A1 lateral where a seepage rate of 3.0 was measured in ponding tests.

(C.Grenier, 10/20/94, /newlands/delivrec/lat_anal.1)

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A8 - A14	**Use 2.0** since these laterals are between the A1 and A15 lateral where seepage rates of 3.0 and 1.4, respectively, were measured in ponding tests.
A15	**Use 1.4** based on 1992-93 ponding tests
A16 - A21	**Use 1.4** since these laterals are in the same area as the A15 lateral where a seepage rate of 1.4 was measured in ponding tests.
D	**Use 1.5**. Soils are sandy. This rate is ~75 percent of the rate used for the T Canal because it is downstream from the T Canal and seepage rates tend to decrease on the Project as you go downstream. No seepage rate was assigned for deliveries to 31-Corporation, which is a special case because deliveries do not flow through a confined channel. This main canal is not constantly in use during the irrigation season.
E	**Use 2.0**. The E Canal intercepts the mid-A Canal laterals for which 2.0 is also used. The V1 lateral ponding test nearby also yielded 2.0. Soils are sandy. This main canal is used rarely to intermittently.
G	**Use 1.4**, same as 1.4 measured at A15 ponding test nearby. Soils are sandy. This main canal is not constantly in use during the irrigation season.
L, L1	**Use 0.3**. Ponding test in the L Canal area show: L1-1 1.6 L5 0.7 (near main L canal) L8 1.5 The main L Canal and L1 lateral are in use all year and probably have a lower seepage rate than intermittently used laterals, so use 0.3, approximately half of the 0.7 rate measured at the L5 lateral near the main L Canal.
L1-1	**Use 1.6** based on ponding test.
L2, L6, L7, L9, L11	**Use 0.7**. All these canals are near the main canal like the L5 lateral where 0.7 was measured.
L5	**Use 0.7** based on 1992-93 ponding tests

L8	**Use 1.5** based on 1992-93 ponding tests
other L laterals	**Use 1.5** which agrees closely with the results from ponding tests at nearby locations: L1-1, L8, and A15.
N	**Use 2.0** based on 1992-93 ponding tests. Soils are sandy. This main canal is not constantly in use during the irrigation season.
N1 - N7	**Use 2.0** since they are in the same area as the N Canal ponding test which had a seepage rate of 2.0.
N8 - N12	**Use 1.5** since these laterals are closer to the Carson River where soils tend to have more fines and lower seepage rates.
R	**Use 0.4**. The R canal and laterals are close to the S17 and S18 ponding tests which yielded seepage rates of 0.4 and 0.3, respectively. Use the higher of the two numbers since the R system is upstream of the two test areas and might have slightly higher seepage.
Rock Dam Ditch	**Use 2.0**. Rock Dam Ditch is on the extreme upstream end of the Project in sandy soils. It is nearest to the ponding test sites on the N Canal and V1 lateral, both with seepage rates of 2.0. This canal is not constantly in use during the irrigation season.
S	**Use 0.15** based on Reclamation ponding test in March 1990.
S1 - S13	**Use 1.0** for laterals upstream from the R-S bifurcation, which are between the R system and the lower L laterals where 0.4 and 1.5 were used, respectively.
S14 - S26	**Use 0.3** for laterals downstream from the R-S bifurcation since they are in the same area as the S17 and S18 laterals where seepage rates of 0.3 and 0.4 were measured in ponding tests.
T Canal	**Use 2.0** for main canal based on nearby N Canal ponding test.
T1 - T10	**Use 2.0** for first 10 laterals based on nearby N Canal ponding test.
T11 - T18	**Use 1.5** for last 8 laterals, same rate used for nearby D Canal laterals.
Truckee Canal	**Use 1.1** for main canal based on ponding test.

(C.Grenier, 10/20/94, /newlands/delivrec/lat_anal.1)

TC1 - TC13	**Use 2.0** for Truckee Canal laterals. The 2.0 rate was measured in the ponding tests on the nearby N Canal.
V	**Use 0.2**. A seepage rate of 0.15 was measured in a ponding test on the main S Canal, which is an extension of the V Canal. But the V Canal runs through considerably sandier soils so use a slightly higher rate of 0.2.
V1	**Use 2.0** based on ponding test.
V2, V3, V7, V10, V13	**Use 1.0** for these canals between the main canal and the Carson River.
V4	**Use 3.0**, the same rate used for the nearby A1 lateral
V5, V6, V8, V9, V11, V12	**Use 1.5**, the same rate used for the nearby upper L Canal laterals.

Selection of Estimated Wetted Perimeters for Project Canals

Wetted perimeters for project canals and laterals were estimated using personal knowledge of the Project by Reclamation personnel in the Lahontan Basin Area Office and the following limited data; these wetted perimeters were observed and measured in Project canals during water measurements made between 1984 and 1993:

A .... av.28'
40,43,28,34,29,23,17,28,25,30,15
A4 .... 8'
A9 .... 8'
A15 .... 21'
A19-1 .... 6'

D* .... 13'
D1 .... 12.5'
D3 .... 10'

E .... 8.5'

L below L-C1 .... 42'
L near L-C7 .... av.46'
45,46,54,37,47,53,33,49
L1 .... 30'
L1-1 .... 14'
L1-3 .... 9'
L1-7 .... 8'
L3 .... 12'
L4 head* .... 9'
L4* .... 8'
L4 .... 12'
L4-1 .... 8'
L6 .... 9'
L8* .... 14'
L10 .... 7'
L12* .... 8'

N - .... av.17'
21,16,18,16,18,15

R* .... 18', 21'
R3 .... 3'

S .... av.39'
39,36,36,42,39,39,45,39,40,37,37,38
S* below Venturacci drop .... 42', 44'

S upstream from R-S Bifurcation .... 46'
S below R-S bifurcation .... 34'
S below Harmon inlet .... 47'
S4 .... 15'
S6 head .... 23'
S6 .... 14'
S10* .... 8'
S13* .... 9'
S16* .... 6',10',10'
S17 .... 22'
S19* .... 8'

Rock Dam Ditch .... 4', 21', 24'
RDD over river .... 5.5'
RD-1 .... 14'

T .... av.26'
32,31,29,26,28,26,26,23,24,26,20
T2 .... 14'

Truckee Canal below Bango .... 38', 40'
Truckee Canal below Hazen .... 39'
TC5 .... 16',17',18',18'
TC6 .... 12',13',14'
TC8 .... 6', 9', 9'
TC8-1 .... 15'
TC13 .... 12'

V .... av.63'
diversion to 26'-drop .... 80'
near turnout to Sheckler Res .... 85',67'
Lewis drop to A Canal head .... 71',70'
A Canal head to V-C3 .... 61'
V-C4 to L Canal head .... 60'
L Canal head to V-C7 .... 52',55'
V-C7 to Venturacci drop .... 48',49'

V3* .... 7', 8'
V7 .... 12'

* Measurement made at a bridge. The cross section of a canal usually decreases under a bridge as the channel constricts, and the wetted perimeter measured there is generally less than that of the canal on either side of the bridge. The wetted perimeters based on measurements made at a bridge are actual figures, but they were increased slightly before being used in this analysis to more accurately represent the canal.

(C.Grenier, 10/20/94, /newlands/delivrec/lat_anal.1)

Estimated 1993 Losses & Water Use Per Irrigated Acre
Newlands Project

canal system	deliveries (ac-ft)	estimated seepage (ac-ft)	total (ac-ft)	irrigated water-righted acres	seepage loss per irrigated acre (ac-ft)	total water used per irrigated acre (ac-ft)
A	26,311.31	7,280	33,591	8,137.7	0.89	4.1
D[1]	4,472.37	1,898	6,370	1,217.7	1.56	5.2
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Rock Dam Ditch[6]	3,164.05		3,164		??	??
S[7]	44,942.36	8,243	53,185	14,346.5	0.57	3.7
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2 Figures for the E Canal are missing information for the E2 and E3 laterals whose deliveries comprise 29 percent of E Canal deliveries; data on the length of these canals was not available. Also, note that unlike other Project canals, deliveries to E Canal turnouts are not diverted through the head of the E Canal at Sheckler Reservoir as they used to be until 1991. They are instead routed through the A Canal.

3 The length of the GD lateral, whose deliveries comprise less than 1 percent of G Canal deliveries, was not available so its seepage estimate is not included.

4 The lengths of the L3, L3-1, L3-2, L8-2-3, L8-2-4, and L10-1-1 laterals and sublaterals, whose deliveries comprise 4 percent of L Canal deliveries, were not available so their seepage estimates are not included.

5 The lengths of the R4-1, R7-3, R10, R11, R11-1, and R12 laterals and sublaterals, whose deliveries comprise 16 percent of R Canal deliveries, were not available so their seepage estimates are not included.

6 The lengths of all 3 Rock Dam Ditch canals and laterals were not available and their seepage estimates were not included.

7 The lengths of the S7-3, S7-4, S7-5, S10-1, S25-2, S26 and S26-4 laterals and sublaterals, whose deliveries comprise 7 percent of S Canal deliveries, were not available so their seepage estimates are not included.

8 The lengths of the T6-1, T7-1, and T17 laterals and sublaterals, whose deliveries comprise 2 percent of T Canal deliveries, were not available so their seepage estimates are not included.

9 The lengths of the Truckee Canal laterals and sublaterals were not available so their seepage estimates are not included.

10 The lengths of the V1-1 and V1-2 sublaterals, whose deliveries comprise 4 percent of V *Canal deliveries,* were not available so their seepage estimates are not included.

(C.Grenier, 10/20/94, /newlands/delivrec/lat_anal.1)

Comments On Table

The table gives a general idea of where losses on the Project are greatest and the estimated relative losses among the various canal systems. Due to the amount of data which are estimated, the results in the table should not be taken as gospel.

In decreasing order of seepage loss rates, it appears that the T and N canal systems require that more water be diverted per acre-foot delivered than for other canal systems on the Project. The R, S and A canal systems have the lowest loss rates.

The estimated total 1993 seepage for the Carson Division is 63,100 acre-feet, as shown on the last page of the following spreadsheet. The estimated 1989 Carson Division seepage calculated in the Newlands Efficiency Study is ~80,000 acre-feet; during both 1993 and 1989, 100 percent of maximum allowable entitlements were available to irrigators so these two years are comparable. The 63,100 acre-feet of seepage estimated on the spreadsheet is likely lower than the actual seepage because data for some laterals is missing and no seepage was calculated. Also, it is likely there are errors in assumptions used to estimate seepage. No adjustments were made to the spreadsheet and seepage rates since that would not change the relative values among the various canal systems, which is what we are interested in for this analysis.

The seepage losses in the table are estimated only for the canal system itself, not for upstream canals. For instance, the table show losses of 5,362 acre-feet for the G canal system but that does not include the losses the G system deliveries experienced as they travelled through the V Canal and A Canal to reach the G Canal. Only the V, T Rock Dam Ditch and Truckee canals do not have additional losses in upstream canal systems. For the A, D, E, G, L, N, R and S systems there are additional seepage losses in upstream canals.

Keep in mind that it is unlikely the main A, V, or S canals will be removed from service because they will probably be necessary to deliver water to Stillwater Wildlife Management Area, Carson Lake Pasture, and the Fallon Indian Reservation. For this reason it would be useful to analyze laterals separately from their associcated main canals.

This analysis only looked at whole canal systems, e.g, the main T canal and all its laterals and sublaterals in aggregate. A more detailed analysis which looks at larger laterals as well might show that some laterals on a canal (especially the main A, V, and S canals which are not likely to be removed from service) are better candidates than others for retiring. For example, laterals which branch off to the north of the V Canal may have lower seepage rates than those branching to the south because the north canals are on a small area of land between the canal and the Carson River where the water table may be higher and seepage rates lower. Gathering the data needed to perform such an analysis could be time-consuming, so a more detailed analysis is not a trivial exercise. It would be good to confirm whether the seepage rates assumed for main canals are valid by performing ponding tests, although these are difficult to arrange during the irrigation season because the canal is always in use. For canals such as the V, S, and A which are not likely to be taken out of service no matter how much seepage they experience (since they are needed to make deliveries to wetlands and the reservation), if a ponding test did confirm a high seepage rate the canal might be a good candidate for lining.

More ponding tests would provide better seepage data. More data on the geometry of project canals would also improve the accuracy of this analysis. As mentioned in the table notes, data for some laterals are missing. This had only a minor effect on seepage estimates for most laterals with the exception of Rock Dam Ditch and the Truckee Canal; no seepage was estimated for these two systems because too much data was missing to make an estimate.

(C.Grenier, 10/20/94, /newlands/delivrec/lat_anal.1)

1993 Deliveries to Newlands Laterals /NEWLANDS/DELIVREC/LATERALS.WK3 (10/19/94) C.Grenier

* sublaterals which have no records of deliveries in 1993
'1993 days used' determined by splitting acre-feet for each delivery among all turnouts listed
Shaded areas indicate measured quantities; other values are estimated.

canal	lateral	sub-lateral	sub-sub-lateral	wetted perim (feet)	length (miles)	portion lined (miles)	canal alone records	canal alone AF	canal & sublaterals records	canal & sublaterals AF	AF delivered per mile	seepage rate (ft3/ft2/day)	1993 days used	seepage losses (AF)
A				28	17.10	0.83	434	6,348.40	1922	26,311.31	371	0.2	197	2,287
	A1			20	2.35		174	1,316.91			560	3.0	76	1,299
	A2			12	2.40	0.71	79	1,446.28	137	1,756.18	603	3.0	79	827
		A2-1		6	0.50		58	309.90			620	3.0	27	29
	A3			6	0.57		22	170.01			298	3.0	21	26
	A4			8	0.25		205	1,460.77	231	1,867.38	5843	3.0	107	78
		A4-1		6	0.20		26	406.61			2033	3.0	38	17
		A4-2*			0.30							3.0	0	0
		A4-3*			0.25							3.0	0	0
	A5			8	1.85		155	988.04	301	2,044.96	534	3.0	109	587
		A5-1		6	1.20		54	597.71			498	3.0	50	131
		A5-2		6	0.95		92	459.21			483	3.0	53	110
	A6			6	1.05		54	246.80			235	3.0	31	71
	A7			6	0.15		21	418.15			2788	3.0	28	9
	A8			6	0.55		19	446.69			812	2.0	20	16
	A9			8	1.20		93	815.10	203	2,380.46	679	2.0	114	265
		A9-1		6	0.10		17	91.16			912	2.0	18	3
		A9-2		6	0.20		21	498.87			2494	2.0	26	8
		A9-3		6	0.70		19	319.92			457	2.0	26	26
		A9-4		6	1.70		22	417.29			245	2.0	28	69
		A9-5		6	1.35		31	238.12			176	2.0	26	51
	A10*				0.20							2.0	0	0
	A11			6	0.40		10	197.43			494	2.0	12	7
	A12			6	1.00		27	422.36			422	2.0	26	38
	A13			8	0.50		39	762.81			1526	2.0	47	46
	A14*				0.40							2.0	0	0
	A15			21	3.50		124	5,087.36	136	5,526.22	1454	1.4	90	1,123
		A15-1		6	0.50		12	438.86			878	1.4	21	11
	A16			8	1.50		31	1,272.80			849	1.4	32	65
	A17			6	0.50		6	206.98			414	1.4	12	6
	A18*				1.60						0	1.4	0	0
	A19			8	0.95		49	617.94	65	758.38	650	1.4	43	55
		A19-1		6	1.15		16	140.44			0	1.4	10	12
	A20			6	0.55		12	168.39			306	1.4	17	10
	A21*				1.50						0	1.4	0	0
TOTALS					49.17	1.54	1,922	26,311		average =	535			7,280

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canal	lateral	sub–lateral	sub–sub–lateral	wetted perim (feet)	length (miles)	portion lined (miles)	canal alone records	canal alone AF	canal & sublaterals records	canal & sublaterals AF	AF delivered per mile	seepage rate x Q (ft3/ft2/day)	1993 days used	seepage losses (AF)
D				15	5.25	2.95	54	1,144.56	422	4,608.41	218	1.5	110	1,575
	D (31–Corp)						4	135.95					8	0
	D1			12	1.75		291	1,984.62			1134	1.5	54	206
	D2			10	1.00		64	1,073.58			1074	1.5	42	76
		D2–1*			0.40							1.5		0
	D3			10	1.40		9	269.61			193	1.5	16	41
		D3–1*			0.55							1.5		0
TOTALS					10.35	2.95	422	4608.32			445			1,898
E				8.5	5.27		94	1,606.06	135	2,222.67	305	2.0	83	901
	E1			6	3.75		3	–19.31			–5	2.0	1	5
		E1–1*			0.15							2.0		0
		E1–2*			0.10							2.0		0
		E1–3*			0.25							2.0		0
	E2			6			12	162.88			ERR	2.0	10	0
	E3			6			26	473.04			ERR	2.0	31	0
TOTALS					9.52	0	135	2222.67			233			907
G				30	5.76		291	8,172.13	515	14,035.97	1419	1.4	167	4,897
	G1			8	0.65		37	1,600.72			2463	1.4	43	38
	G2			6	0.20		10	112.70			564	1.4	14	3
	G3			8	4.00		28	1,101.84	48	1,529.89	275	1.4	49	266
		G3–1*			0.90							1.4		0
		G3–2		6	0.60		20	428.05			713	1.4	20	12
		G3–3*			1.00							1.4		0
	G4			8	1.00		25	1,657.57			1658	1.4	36	49
	G5			6	1.10		54	524.69	92	914.18	477	1.4	54	60
		G5–1		6	0.95		38	389.49			410	1.4	38	37
			G5–1–1*		0.20							1.4		0
	GD			6			12	48.78			ERR	1.4	10	0
TOTALS					16.36	0.00	515	14,035.97			858			5,362

L	45	9.90	1.03	86	500.15	2873	33,736.56	51	0.3	201	3,256
L1	30	7.25	0.22	646	5,334.91	1478	16,731.03	736	0.3	189	1,495
L1-1	14	2.40		183	1,804.46	192	2,014.56	752	1.6	104	678
L1-1-1	6	0.60		9	210.10			350	1.6	17	12
L1-1-2*		0.80		0	0.00			0	1.6	0	0
L1-2	8	0.30		51	723.88			2413	1.5	60	26
L1-3	9	0.30		35	683.06			2277	1.5	36	18
L1-4	12	0.85		59	2,383.79			2804	1.5	72	134
L1-5	6	0.40		58	352.79			882	1.5	57	25
L1-6	8	1.00		24	950.59			951	1.5	37	54
L1-7	8	2.15		199	2,053.01	200	2,054.87	955	1.5	96	300
L1-7-1	6	0.25		1	1.86			7	1.5	1	0
L1-7-2*		0.25							1.5		0
L1-8	6	0.90		45	635.55	142	1,224.00	706	1.5	81	80
L1-8-1	6	0.75		63	324.65			433	1.5	41	34
L1-8-2	6	0.20		11	79.38			397	1.5	13	3
L1-8-3	6	0.10		13	136.49			1365	1.5	18	2
L1-8-4	6	0.10		10	47.93			479	1.5	11	1
L1-9	6	0.30		44	413.32			1378	1.5	33	11
L1-10	6	0.50		27	595.26			1191	1.5	31	17
L3	12			86	663.26	149	796.55	ERR	1.5	90	0
L3-1	6			44	104.20			ERR	1.5	15	0
L3-2	6			19	29.09			ERR	1.5	17	0
L4	12	1.50		188	1,942.27	516	5,260.65	1295	1.5	164	537
L4-1	8	1.60		126	935.17	184	1,083.71	584	1.5	96	223
L4-1-1	6	1.25		16	51.69			41	1.5	17	23
L4-1-2	6	0.50		42	96.85				1.5	17	9
L4-1-3	6			0	0.00				1.5		0
L4-2	6	0.30		30	296.28			988	1.5	24	8
L4-3	8	0.40		59	1,130.69			2827	1.5	53	31
L4-4	8	1.10		55	807.70			734	1.5	50	80
L5	8	1.95		68	836.79			429	0.7	61	81
L6	9	1.75		108	918.15			525	0.7	59	79
L7	6	1.20		86	638.00			532	0.7	47	29
L8	16	5.90	0.50	107	1,628.52	294	5,626.37	276	1.5	140	2,403
L8-1	6	0.75		38	348.14			464	1.5	25	20
L8-2	8	4.60		22	612.58	65	1,596.86	133	1.5	52	348
L8-2-1	6	0.60		13	254.07			423	1.5	23	15
L8-2-2	6	0.20		16	246.26			1231	1.5	17	4
L8-2-3	6			2	108.32				1.5	4	0
L8-2-4	6			12	375.63				1.5	10	0
L8-3	6	1.20		2	27.23			23	1.5	3	4
L8-4	6	0.90		42	673.80			749	1.5	36	35
L8-5	6	0.50		14	599.49			1199	1.5	20	11
L8-6	6	0.75		18	618.59			825	1.5	26	21
L8-7	6	0.50		8	133.74			267	1.5	7	4
L9	6	0.35		10	207.77			594	0.7	14	2
L10	7	1.80		24	650.26	48	1,323.55	361	1.5	59	135
L10-1	6	3.00		14	309.68	18	458.11	103	1.5	30	98
L10-1-1	6			4	148.43			ERR	1.5	8	0
L10-1-2*		1.20						0	1.5		0
L10-2	6	0.70		6	215.18			307	1.5	12	9
L11	6	0.50		10	319.62			639	0.7	12	3
L12	8	5.50		3	31.42	20	577.93	6	1.5	21	168
L12-1	6	0.80		4	281.89			352	1.5	8	7
L12-2*		0.20							1.5		
L12-3	6	0.50		13	264.62			529	1.5	14	8
TOTALS		71.3	1.75	2873	33,736.56			473			10,540

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canal	lateral	sub-lateral	sub-sub-lateral	wetted perim (feet)	length (miles)	portion lined (miles)	canal alone records	canal alone AF	canal & sublaterals records	canal & sublaterals AF	AF delivered per mile	seepage rate x Q (ft3/ft2/day)	1993 days used	seepage losses (AF)
N				17	6.50	0.00	233	1,614.95	582	4,262.94	248	2.0	152	4,072
	N1			10	0.35		18	311.55			890	2.0	25	21
	N2			10	0.35		15	406.48			1161	2.0	20	17
	N3			10	0.90		36	165.13			183	2.0	30	65
	N4			10	0.45		6	82.50			183	2.0	8	9
	N5			10	0.55		46	419.19			762	2.0	37	49
	N6			10	0.90		68	666.46			741	2.0	56	122
	N7			8	0.25		13	164.50			658	2.0	17	8
	N8			8	0.15		9	45.78			305	1.5	10	2
	N9			8	0.40		62	244.44			611	1.5	33	19
	N10			8	0.35		67	131.39			375	1.5	31	16
	N11			8	0.40		8	3.97			10	1.5	8	5
	N12			8	0.30		1	6.60			22	1.5	2	1
TOTALS					12	0	582	4,262.94			360			4,407
R				22	5.26		77	1,643.78	538	6,559.85	313	0.4	159	981
	R1			6	0.40		21	351.36			878	0.4	20	2
	R2			8	3.20		42	973.45	56	1,150.80	304	0.4	62	77
		R2–1		6	0.70		14	177.35			253	0.4	19	4
		R2–2*			0.95							0.4		0
		R2–3*			1.00							0.4		0
	R3			3	0.75		36	361.33			482	0.4	38	4
	R4			6	2.00		60	460.83	73	616.72	230	0.4	53	31
		R4–1		6			13	155.89				0.4	18	0
	R5			6	1.25		6	35.70			29	0.4	6	2
		R5–1*			0.40							0.4		0
	R6			8	2.30		65	658.71	70	701.08	286	0.4	56	50
		R6–1		6	0.45		5	42.37			94	0.4	9	1
		R6–2*			0.35							0.4		0
		R6–3*			0.70							0.4		0
		R6–4*			0.20							0.4		0
	R7			6	1.50		54	494.00	55	499.78	329	0.4	47	21
		R7–3		6			1	5.78				0.4	2	0
	R8			6	0.25		18	118.01			472	0.4	20	1
	R9			6	1.30		20	166.74			128	0.4	23	9
		R9–1*			0.10							0.4		0
		R9–2*			1.20							0.4		0
		R9–3*			0.25							0.4		0
	R10			6			1	7.94			ERR	0.4	2	0
	R11			6			32	205.53	72	492.20	ERR	0.4	46	0
		R11–1		6			40	286.67			ERR	0.4	32	0
	R12			6			33	414.41			ERR	0.4	37	0
TOTALS					25	0	538	6,559.85			268			1,183
RD				22			178	2,487.34	209	3,164.05	ERR	2.0	101	0
	RD–1			14			26	555.10			ERR	2.0	24	0
	RD2			6			5	121.61			ERR	2.0	8	0
TOTALS					0	0	209	3,164.05			ERR			0

S		42	18.60		593	12,286.73	2645	44,942.36	661	0.15	211	2,997
S1		8	0.45		27	585.20			1300	1.0	25	11
S2		6	1.25		106	483.49			387	1.0	33	30
S3		8	0.90		49	936.28			1040	1.0	43	38
			0.30									
S4		15	0.50		20	495.79			992	1.0	21	19
S5		8	3.00	2.05	64	639.88	86	674.65	213	1.0	53	154
	S5–1	6	0.75		22	34.77			46	1.0	16	9
	S5–2*		0.17							1.0		0
S6		18	6.80		309	3,484.49	479	6,365.13	512	1.0	175	2,596
	S6–1	6	0.75		33	497.28			663	1.0	32	17
	S6–2	10	0.70		61	1,306.65			1867	1.0	50	42
	S6–3	6	0.50		26	461.00			922	1.0	30	11
	S6–4	6	1.00		17	370.37			370	1.0	21	15
	S6–5	6	0.90		5	67.40			75	1.0	6	4
	S6–6	6	0.20		28	177.94			890	1.0	25	4
S7		16	4.20	2.95	178	2,879.97	294	4,655.21	686	1.0	150	1,222
	S7–1	6	0.65		20	441.31			679	1.0	22	10
	S7–2	8			33	591.08			ERR	1.0	32	0
	S7–3	8			43	554.67			ERR	1.0	49	0
	S7–4	6			8	62.97			ERR	1.0	9	0
	S7–5	6			12	125.21			ERR	1.0	19	0
S8		12	1.25	1.25	102	1,183.55			947	1.0	63	115
S9		8	0.25		18	104.38			418	1.0	19	5
S10		10	0.90		60	575.80	61	605.39	640	1.0	46	50
	S10–1	6			1	29.59			ERR	1.0	2	0
S11		8	0.50		32	507.55			1015	1.0	32	16
S12		8	0.20		35	370.44			1852	1.0	35	7
S13		11	1.70		79	1,070.83			630	1.0	59	134
S14		8	0.60		20	182.42			304	0.3	28]	
S15		8	0.15		54	283.37			1889	0.3	34	1
S16		12	1.50		41	508.13			339	0.3	40	26
S17		22	4.60	1.50	157	3,444.17	185	4,008.75	749	0.3	113	416
	S17–1*		0.50							0.3		0
	S17–2	6	0.30		1	5.10			17	0.3	1	0
	S17–3	6	0.40		2	17.33			43	0.3	2	0
	S17–4	8	0.40		24	537.20			1343	0.3	25	3
	S17–5*		0.15							0.3		0
	S17–8	6			1	4.95			ERR	0.3	1	0
S18		8	0.80		23	614.46			768	0.3	34	8
S19		10	3.60		18	222.26	36	598.17	62	0.3	41	54
	S19–1	6	0.45		18	375.91			835	0.3	27	3
S20		8	0.50		18	150.81			302	0.3	22	3
S21		8	0.50		38	481.17			962	0.3	31	5
S22		16	2.96		72	2,201.08	107	2,544.47	744	0.3	91	157
	S22–1	6	0.39		35	343.39			880	0.3	24	2
S23		8	0.16		10	345.39			2159	0.3	16	1
S24		8	0.16		20	272.41			1703	0.3	32	1
S25		18	1.00		73	2,713.38	82	3,157.50	2713	0.3	90	59
	S25–2	6			9	444.12			ERR	0.3	18	0
S26		12			17	760.06	30	1,470.69	ERR	0.3	46	0
	S26–4	8			13	710.63			ERR	0.3	24	0
TOTALS			66	8	2,645	44,942.36			686			8,243

013822

canal	lateral	sub-lateral	sub-sub-lateral	wetted perim (feet)	length (miles)	portion lined (miles)	canal alone records	canal alone AF	canal & sublaterals records	canal & sublaterals AF	AF delivered per mile	seepage rate x Q (ft3/ft2/day)	1993 days used	seepage losses (AF)
T				26	14.40	7.45	794	6,489.30	668	17,926.21	451	2.0	191	17,336
	T1			6	0.10		19	103.26			1033	2.0	20	3
	T2			14	0.20		29	146.22			731	2.0	25	17
	T3			6	0.49		9	48.65			99	2.0	9	6
	T4			8	0.85		22	456.31			537	2.0	30	49
	T5			10	1.05		30	741.25			706	2.0	36	92
	T6			10	2.50		140	827.02	160	996.09	331	2.0	62	376
		T6-1		6			20	169.07			ERR	2.0	21	0
	T7			12	1.25		102	914.01	115	1,044.61	731	2.0	70	255
		T7-1		6			13	130.60			ERR	2.0	16	0
	T8			6	1.60		44	432.49			270	2.0	34	79
	T9			6	0.70		41	383.69			548	2.0	33	34
	T10			6	0.10		22	90.29			903	2.0	20	3
	T11			14	1.55		111	1,123.14			725	1.5	75	296
	T12			6	1.05		51	440.69			420	1.5	47	54
	T13			20	4.25		85	2,368.29			557	1.5	58	896
	T14			6	0.50		12	440.74			881	1.5	20	11
	T15			16	0.70		49	1,429.74			2042	1.5	60	122
	T16			8	1.10		43	649.25			590	1.5	41	66
	T17			6			3	23.25			ERR	1.5	3	0
	T18			8	0.70		29	518.95			741	1.5	37	38
TOTALS					33.09	7.45	1668	17,926.21			542			19,732

013823

canal	lateral	sub-lateral	sub-sub-lateral	wetted perim (feet)	length (miles)	portion lined (miles)	canal alone records	canal alone AF	canal & sublaterals records	canal & sublaterals AF	AF delivered per mile	seepage rate x Q (ft3/ft2/day)	1993 days used	seepage losses (AF)
TC				40			102	1,113.89	1399	16,488.19	ERR	1.1	202	0
	TC1			6			51	214.03	63	226.17	ERR	2.0	7	0
		TC1-1		6			12	12.14			ERR	2.0	7	0
	TC2			6			25	252.06	37	256.59	ERR	2.0	38	0
	TC2A			6			12	4.53			ERR	2.0	12	0
	TC3			8			69	514.99			ERR	2.0	76	0
	TC4			10			58	603.66	115	1,047.88	ERR	2.0	98	0
		TC4-1		6			57	444.22			ERR	2.0	46	0
	TC5			18			70	378.57	184	2,347.25	ERR	2.0	135	0
		TC5-1		10			46	1,181.52			ERR	2.0	68	0
		TC5-2		6			17	324.89			ERR	2.0	26	0
		TC5-3		6			16	133.99			ERR	2.0	16	0
		TC5-4		6			35	328.28			ERR	2.0	35	0
	TC6			13			74	1,024.07	105	1,465.30	ERR	2.0	105	0
		TC6-1		6			31	441.23			ERR	2.0	40	0
	TC7			8			59	673.00			ERR	2.0	75	0
	TC8			9			104	1,556.02	128	1,907.99	ERR	2.0	120	0
		TC8-1		15			24	351.97			ERR	2.0	39	0
	TC9			6			31	84.10			ERR	2.0	29	0
	TC10			6			24	265.32	38	589.24	ERR	2.0	57	0
		TC10-1		6			14	323.92			ERR	2.0	27	0
	TC11			10			11	1,088.04			ERR	2.0	18	0
	TC12			8			68	760.85	113	1,376.82	ERR	2.0	107	0
		TC12-1		6			14	143.22	29	302.17	ERR	2.0	33	0
			TC12-1-2	6			15	158.95			ERR	2.0	17	0
		TC12-2		6			16	313.80			ERR	2.0	25	.0
	TC13			12			181	2,292.77	344	3,796.93	ERR	2.0	143	0
		TC13-1		10			101	1,058.41			ERR	2.0	82	0
		TC13-2		6			62	445.75			ERR	2.0	42	0
TOTALS					0	0	1399	16,488.19			ERR			0

013824

canal	lateral	sub-lateral	sub-sub-lateral	wetted perim (feet)	length (miles)	portion lined (miles)	canal alone records	canal alone AF	canal & sublaterals records	canal & sublaterals AF	AF delivered per mile	seepage rate x Q (ft3/ft2/day)	1993 days used	seepage losses (AF)
V				63	12.40		428	2,380.74	1637	11,411.67	192	0.1	195	1,846
	V1			10	1.98		184	1,226.04	232	1,631.84	619	2.0	93	446
		V1-1		6			32	171.31			ERR	2.0	30	0
		V1-2		6			16	234.49			ERR	2.0	20	0
	V2			6	0.36		28	188.83			525	1.0	28	7
	V3			10	0.56		56	413.67	63	488.77	739	1.0	45	31
		V3-1		6	0.64		7	75.10			117	1.0	8	4
	V4			16	1.68		189	1,543.20			919	2.0	101	658
	V5			10	1.56		217	1,114.71			715	1.5	92	261
	V6			6	0.28		59	402.90			1439	1.5	37	11
	V7			12	0.76		49	389.08	57	652.39	512	1.0	50	55
		V7-1		6			8	263.31			ERR	1.0	15	0
	V8			16	0.68		75	1,713.30			2520	1.5	21	42
	V10			6	0.32		17	98.96			309	1.0	15	3
	V11			8	1.52		214	776.99			511	1.5	90	199
	V12			6	0.24		32	82.75			345	1.5	31	8
	V13			6	0.22		26	336.23			1528	1.0	22	4
TOTALS					23.2	0	1637	11,411.61			ERR			3,576
ASSESSMNT							151	115.80					0	0
CANAL							34	87.46					56	0
CONTROL							11	15.67					0	0
EASTSIDE POINT RES							8	1,012.50					15	0
HARMON RESERVOIR							1	287.98					0	0
HORSEGATE DRAIN							3	605.28					4	0
LEE DRAIN							4	783.01					5	0
NONE							1	7.92					1	0
OVERRUN							1	0.61					0	0
PAIUTE DRAIN							8	894.76					16	0
PIPELINE							1	14.01					0	0
PUMP													24	0
RATTLESNAKE OUTLET							12	231.57					13	0
RECLAMATN							3	33.74					0	0
RICE DRAIN							3	1,210.37					6	0
RRA							2	0.00					0	0
S-LINE RESERVOIR							1	287.98					0	0
SAGOUSPI #1							8	68.37					8	0
STILLWATR POINT RES							0	0.00					0	0
SUBDIVSON							13	74.32					0	0
TEMP TRAN							89	0.00					0	0
TRANSFER							1	3.50					0	0
WESTSIDE							6	3,249.36					11	0
Total 1993 Project Seepage (AF)														63,128

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